# SYLLABUS FOR PRIMARY SCHOOL MATHEMATICS

## General Points for Text Book Writers

1. The following syllabus has been developed keeping the philosophy of the Yashpal Report and the National Focus Group for Teaching Learning Mathematics in view. Keeping in mind the reality of the number of hours that teaching actually takes place in the school, we have kept a thumb rule of 140 periods, of 30-40 minutes each, per year for mathematics. Within this the number of periods allotted to each area is given in the syllabus. However, this is just to give an **approximate idea** of the weightage to be given to a particular topic by writers and others who are transacting the syllabus. **This break-up of time should not be taken as an exact writ by teachers.**

2. We need to encourage the development of a culture of **learning outside the classroom**. If a topic is linked well with experiences, interesting exercises given then conceptual learning of math would continue beyond the 140 periods.

3. The syllabus has been developed in five very natural streams flowing from Class I to Class V, **which overlap** very often, not only with each other but also with themes developed in other subjects that are being learnt simultaneously.

4. While developing the study material, we expect the focus to be activities/exercises, built around children's real-life experiences and from areas across the curriculum. They need to be created in a manner that would meet more than one objective simultaneously, and cover more than one stream at the same time. Further, we must include **extensions to activities** as **part of the main course material**, and not as a supplement, for the learners who feel encouraged to do them. However, as for any activity or experience, the teachers would need to give enough leeway to children, or modify the activity, to suit their interests. In this context, it is important that **children's current local interests and enthusiasms be utilized to the maximum as opportunities for developing math concepts. Enough space, in various ways, must be given for this in the textbooks.**

5. **Mathematics is about** a **certain way of thinking and reasoning**. This should be reflected in the way the materials are written and other activities and exercises created. The teachers' training should reflect this also. Particular stress must be given to allow the child to **articulate her reasons** behind doing an exercise in a certain way, for example, why she is continuing a pattern in a particular way. Such interactive learning will require the teacher to plan for more time to be given for certain concepts in the classroom, and the textbooks would need to allow for this.

6. The **Class 1 & 2 books would be workbooks** with short footnotes for the teacher about suggestions for dealing with the particular topic. (In fact, such footnotes should probably be incorporated in all the primary books.) The Class 1 workbook and the other materials would be created with the view to consolidate the mathematical concepts and experiences that the child already has before she joins school, and to build on this background.

7. The language used in the books for Classes 3 to 5 should be what the child would normally use and would understand.

8. The sequencing of the concepts should not be linear, but spiral.

**9. The book should not appear to be dry and should be attractive to children in various ways. The points that may influence this include the language, the nature of descriptions and examples, inclusion or lack of illustrations, inclusion of comic strips or cartoons to illustrate a point, inclusion of stories and other interesting texts for children.**

10. While dealing with problems, the text books should have several situations with multiple correct solutions. Make the children aware that there can be several strategies for teaching a problem.

11. The material regarding patterns should be created in a way that would allow the child to observe patterns to generalise them, and to develop her own patterns.

**12. The purpose is not that the children would learn known definitions and therefore never should we begin by definitions and explanations. Concepts and ideas generally should be arrived at from observing patterns, exploring them and then trying to define them in their own words. There should be no overt emphasis on remembering definitions in known standard forms in exactly the same words.**

13. Problem posing is an important part of doing maths. Exercises that require children to formulate and create a variety of problems for their peers and others should be built in

# Syllabus for Primary Mathematics

| CLASS 1 | CLASS II | CLASS III | CLASS IV | CLASS V |
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| **Geometry (14 hrs.)**<br><br>**Shapes & Spatial Understanding**<br><br>• Develops and uses vocabulary of spatial relationship (Top, Bottom, On, Under, Inside, Outside, Above, Below, Near, Far, Before, After)<br><br>**Solids around us**<br>• Sorts, Classifies and describes in their own words the objects like pebbles, pipes, balls, cones of shapes, and other observable properties.<br>• Observes and describes the way shapes affect movements like rolling and sliding.<br>• Sorts 2 - D shapes such as flat objects made of card etc. (triangle, rectangle and circle)<br>• Draws circles, triangles and rectangles freehand. | **Geometry (15 hrs.)**<br><br>**Shapes & Spatial Understanding**<br><br>**3-D and 2-D Shapes**<br>• Observes objects in the environment and gets a qualitative feel for their geometrical attributes such as roundness, edges, face, corner, vertex (apex).<br>• Identifies the basic 3-D shapes such as cuboid, cylinder, cone, sphere by their names.<br>• Identifies 2-D shapes viz., rectangle, square, triangle, circle by their names.<br>• Traces the 2-D outlines of 3-D objects.<br>• Observes and identifies these 2-D shapes.<br>• Describes in her own words the properties of these 2-D shapes.<br>• Identifies and makes straight lines by folding, straight edged objects, stretched strings and draws free hand and with a ruler.<br>• Draws horizontal, | **Geometry (18hrs.)**<br><br>**Shapes & Spatial Understanding**<br><br>• Creates 2D shapes through paper folding/ paper cutting and identifies them.<br>• Describes the various 2-D shapes by counting their sides, corners and diagonals.<br>• Makes shapes using straight lines and curves on the dot-grid.<br>• Creates shapes using tangram pieces.<br>• Matches the properties of two 2-D shapes by observing their sides and corners (vertices).<br>• Tiles a given region using a tile of a familiar shape<br>• Distinguishes between shapes that tile and that do not tile.<br>• Intuitive idea of a map. Reads simple maps (not to scale)<br>• Draws some simple 3D-objects, using ruler/ free hand.<br>• Explores the relationship | **Geometry (20hrs.)**<br><br>**Shapes & Spatial Understanding**<br><br>• Draws a circle free hand and with compass.<br>• Identifies centre, radius and diameter of a circle.<br>• Creates different shapes using tangrams etc.<br>• Tiles geometrical shapes: using one or two shapes. Equilateral triangle/ Hexagon .<br>• Explores intuitively the perimeter and area of simple shapes.<br>• Makes 4-faced, 5-faced and 6-faced solids from given nets especially designed for the same.<br>• Reads and draws 3-D objects, making use of the familiarity with the conventions used in this.<br>• Rotates a coin to generate a sphere.<br>• Creates a hollow cylinder by stacking up bangles. | **Geometry (20 hrs.)**<br><br>**Shapes & Spatial Understanding**<br><br>**Circles**<br>• Draws a circle using compass for given radius<br>• Gets the feel of perspective while drawing a 3-D object in 2-D.<br>• Gets the feel of an angle through observation and paper folding.<br>• Identifies right angles in the environment.<br>• Classifies angles into right, acute and obtuse angles.<br>• Represents right angle, acute angle and obtuse angle by drawing and tracing.<br>• Explores intuitively the reflections through inkblots, paper cutting and paper folding.<br>• Explores intuitively rotations and reflections of familiar 2-D i.e Circle, right angled triangle, rectangle.<br>• Explores intuitively symmetry in familiar 2D |

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| | vertical and slant lines (free hand) and with a ruler.<br>• Distinguishes between straight and curved lines.<br>• Tries to Identify 3D objects by observing their shadows. | between 3D and 2D by arranging coins one upon the other to get the cylinder bangles to get hollow cylinder etc.. | | and 3-D shapes.<br>• Makes the shapes of cubes, cylinders and cones using nets especially designed for this purpose.<br>• Draws intuitively the plan, elevation and side view of simple 3D objects.<br>• Gets familiar with the instrument box and its use. |
| **Numbers (60 hrs.)**<br><br>• Developing a sense of Numberness, Counting and Operations of Numbers 1 - 9 & zero<br><br>• Observes objects and makes collections of objects.<br>• Arranges the collection of objects in order by<br>- Matching and<br>- One to one correspondence<br>• Counts the number of objects in a collection.<br>• Makes collection of objects corresponding to a specific number.<br>• Recognizes and speaks numbers from 1 to 9. Uses numbers from 1 to 9 in counting and comparison. (Real | **Numbers (60 hrs.)**<br><br>• Reads and writes numerals 0 - 99<br>• Expands a number with respect to place values.<br>• Counts and regroups objects into tens and ones.<br>• Uses the concept of place value in the comparison of numbers.<br>• Counts in various ways:<br>- Starting from any number.<br>- Group counting etc.<br>• Arranges numbers upto hundred in ascending and descending order.<br>• Forms the greatest and the smallest two digit numbers with and without repetition of given digits. | **Numbers (54 hrs.)**<br><br>• Number sequence upto 1000<br>• Reads and writes 3-digit numbers.<br>• Expands a number w.r.t. place values.<br>• Counts in various ways.<br>- starting from any number.<br>- Skip counting<br>- Back counting<br>- Compares numbers.<br>• Forms greatest and smallest numbers using given digits.<br><br>**Addition & Subtraction**<br>• Adds and subtracts numbers by writing them vertically in the following two cases -<br>- without regrouping. | **Numbers (50 hrs.)**<br><br>Numbers and operations<br><br>• Writes multiplication facts.<br>• Writes tables upto 10 x10.<br>• Multiplies two and three digit numbers using lattice algorithm and the standard (column) algorithm.<br>• Divides a given number by another number in various ways such as:<br>- by drawing dots.<br>- by grouping.<br>- by using - multiplication facts.<br>- by repeated subtraction.<br>• Applies the four operations to life situations. | **Numbers (50 hrs.)**<br><br>Numbers and operations<br><br>• Finds place value in numbers beyond 1000.<br>• Appreciates the role of place value in addition, subtraction and multiplication algorithms.<br>• Uses informal and standard division algorithms.<br>• Explains the meaning of factors and multiples. |

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| objects and repeated events like clapping to be used for counting)<br>• Reads and writes numerals from 1 to 9.<br>• Adds and subtracts using real objects and pictures. (Sum/difference not exceeding 9)<br>• Reads + and -<br>• Adds and subtracts the numbers using symbols '+' and '-'.<br>• Approaches zero through the subtraction pattern (such as 3-1=2, 3-2=1, 3-3=0). reads and writes zero.<br>• Numbers from (10 - 20)<br>• Forms Number sequence from 10 to 20.<br>• Counts objects using these numbers.<br>• Groups objects into a group of 10s and single objects.<br>• Develops the vocabulary of group of 'tens' and 'ones'.<br>• Shows the group of tens and ones by drawing.<br>• Counts the number of tens and ones in a given number.<br>• Writes ten to twenty using numerals. | • Pre number line.<br>• Addition and Subtraction<br>• Adds and subtracts two digit numbers by drawing representations of tens and ones without and with regrouping.<br>• Adds zero to a number and subtracts zero from a number.<br>• Observes the commulative property of addition through patterns.<br>• Solves addition, subtraction problems presented through pictures and verbal description.<br>• Describes orally the situations that correspond to the given addition and subtraction facts.<br>• Identifies addition and subtraction from a word problem.<br>• Estimates the result of addition and subtraction and compares the result with another given number.<br>• Performs operations like addition on a numberline where the result does not exceed 9. | - with regrouping.<br>• Uses the place value in standard algorithm of addition and subtraction.<br>• Solves addition and subtraction problems in different situations presented through pictures and stories.<br>• Frames problems for addition and subtraction facts.<br>• Estimates the sum of, and difference between, two given numbers not exceeding 99.<br>Multiplication<br>• Explains the meaning of multiplication (as repeated addition).<br>• Identifies the sign of multiplication.<br>• Constructs the multiplication tables of 3,4 and 10<br>• Uses multiplication facts in situations.<br>• Multiplies two digit numbers using standard algorithm and Lattice multiplication algorithm.<br><br>**Division:**<br>• Explains the meaning of division from context of equal grouping and sharing.<br>• Relates division with | • Frames word problems.<br>• Estimates sums, differences and products of given numbers. | |

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| • Compares numbers upto 20.<br>• Addition and Subtraction (upto20)<br>• Adds and subtracts numbers up to 20.<br>• Numbers from 21 - 99<br>• Writes Twenty-one to Ninety nine using numerals .<br>• Groups objects into tens and ones.<br>• Draws representation for groups of ten and ones.<br>• Groups a number orally into tens and ones. | • Relates situations involving repeated addition to multiplication.<br>• Relates situations involving equal grouping to division.<br><br>**Preparation for Multiplication &Division**<br>• Discussion of situations involving repeated addition and situations involving equal sharing.<br>• Activities of making equal groups.<br>Constructs multiplication tables of 1, 2 and 5. | multiplication.<br>• Completes division facts<br>- by grouping<br>- by using multiplication tables. | | |
| **Mental Arithmetic**<br><br>• Adds two single digit numbers mentally. | **Mental Arithmetic**<br><br>• Adds and subtracts single digit numbers mentally.<br>• Adds and subtracts multiples of ten mentally. | **Mental Arithmetic**<br><br>• Adds and subtracts single digit numbers and two digit numbers mentally.<br>• Doubles two digit numbers mentally (result not exceeding two digits).<br><br>**FRACTIONAL NUMBERS**<br>• Identifies half, one fourth and three- fourths of a whole and relates to real life situation.<br>• Identifies the symbols, ½, ¼, ¾.<br>• Explains the meaning of ½ , ¼ and ¾ . | **Mental Arithmetic**<br><br>• Adds and subtracts multiples of 10 and 100, mentally.<br>• Completes multiplication facts by adding partial products, mentally (e.g. 7x6 = 5x6+2x6).<br>• Appreciates equivalence of 2/4 and 1/2; and of 2/2, 3/3, 4/4 and 1.<br>• Understands 0.1, 0.2, 0.3, 0.4, 0.5 .. | **Mental Arithmetic**<br><br>• Estimates sums, differences, products and quotients and verifies using approximation.<br>**FRACTIONAL NUMBERS**<br>• Finds the fractional part of a collection.<br>• Compares fractions.<br>• Identifies equivalent fractions.<br>• Estimates the degree of closeness of a fraction to known fractions (½, ¼, ¾ etc.)<br>• Uses decimal fractions in the context of units of length and money. |

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| | | | | • Expresses a given fraction in decimal notation and vice versa. |
| **Money (6 hrs.)**<br><br>• Identifies common currency notes and coins.<br>• Aquaints with these coins and currency makes the given amount using different combination of coins. 1Re = 100Ps.<br>• Relates cost of material with currency. | **Money (6 hrs.)**<br><br>• Identifies currency - notes and coins.<br>• Puts together amounts of money not exceeding Rs 50/-.<br>• Adds and subtracts small amounts of money mentally.<br>• Aquaints the transaction of amount using 3-4 notes. | **Money (7 hrs.)**<br><br>• Converts Rupee to Paise using play money.<br>• Adds and subtracts amounts using column addition, and subtraction without regrouping.<br>• Aquaints with simple rate charts and bills. | **Money (8 hrs.)**<br><br>• Adds and subtracts amounts using column addition and subtraction with regrouping.<br>• Uses operations to find totals, change, multiple costs and unit cost.<br>• Describes rate charts and bills. | **Money (6 hrs.)**<br><br>Applies the four operations in solving problems involving money.<br>Makes rate charts and bills.<br>Estimates roughly the totals and total cost. |
| **Measurement (18hrs.)**<br><br>**Length**<br>• Distinguishes between near, far, thin, thick, longer/ taller, shorter, high, low.<br>• Seriates objects by comparing their length.<br>• Measures short lengths in terms of non-uniform units (in the context of games e.g. 'Gilli Danda' and 'marble-games').<br>• Estimates distance and length, and verifies using non-uniform units (e.g. hand span etc.)<br><br>**Weight**<br><br>• Compares between | **Measurement (18 hrs.)**<br><br>**Length**<br>• Distinguishes between near, far, thin, thick, longer/taller, shorter, high, low.<br>• Seriates objects by comparing their length.<br>• Measures short lengths in terms of non-uniform units (in the context of games e.g. 'Gilli Danda' and 'marble-games').<br>• Estimates distance and length, and verifies using non-uniform units (e.g. hand span etc.)<br><br>**Weight**<br><br>• Compares between | **Measurement (25hrs.)**<br><br>**Length**<br>• Appreciates the need for a standard unit.<br>• Develops the skill of measurement of length using appropriate standard units of length by choosing between centimetres. and<br>• metres. (No millimetres)<br>• Estimates the length of given object in Standard units and verifies by measuring.<br>• Uses a ruler<br>• Appreciates and expresses the relationship between centimetre and metre. | **Measurement (24hrs.)**<br><br>**Length**<br>• Relates metre with centimetre;<br>• Converts metre into centimetres and vice versa.<br>• Solves problems involving length and distances.<br>• Estimates length of an object and distance between two given locations.<br><br>**Weight**<br>Weighs objects using a balance and standard units.<br>• Determines sums and differences of weights.<br>• Estimates the weight of | **Measurement (26 hrs.)**<br><br>**Length**<br>• Determines area and perimeter of simple geometrical figures. by measuring.<br>• Applies the four operations in solving problems involving length, weight and volume.<br>• Relates commonly used larger and smaller units of length, weight and volume and converts one to the other.<br>• Applies simple fractions to quantities.<br>• Converts fractional larger unit into complete smaller units. |

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| heavy and light objects.<br><br>**Time**<br><br>• Distinguishes between events occurring in time using terms -earlier and later.<br>• Gets the qualitative feel of long & short duration, of school days v/s holidays.<br>• Narrates the sequence of events in a day.<br>• Gets familiar with the days of the week.<br>• Gets familiar with the month of the year. | heavy and light objects<br><br>**Time**<br><br>• Gets more familiar with the days of the week and months of the year and concretises.<br>• Gets a feel for cycline nature of seasons.<br>• Sequences the events occurring over longer periods in terms of dates/days.<br>• Familiarise with yesterday today and tomorrow.<br>• Gets familiar with a 12 page calendar and writes the week days and months (January to December) | **Weight**<br><br>• Weighs objects using non standard Units.<br>• Appreciates the conservation of weight.<br><br>**Volume**<br>• Measures and compares the capacity of different containers in terms of non-standard units.<br>• Appreciates the conservation of volume.<br><br>**Time**<br><br>• Reads a calendar to find a particular day and date.<br>• Reads the time to the nearest hour.<br>• Sequences the events chronologically. | an object and verifies using a balance.<br><br>**Volume**<br>Measures volumes of given liquid using containers marked with standard units.<br>• Determines sums and differences of volumes.<br>• Estimates the volume of a liquid contained in a vessel and verifies by measuring.<br><br>**Time**<br><br>• Computes the number of weeks in a year.<br>• Correlates the number of days in a year with the number of days in each month.<br>• Justifies the reason for the need of a leap year.<br>• Reads clock time to the nearest hours and minutes.<br>• Expresses time, using the terms, 'a.m.' and 'p.m.'<br>• Estimates and verifies the duration of familiar events.<br>• Finds approximate time elapsed by (to the nearest hour) forward counting.<br>• Computes the number of | • Appreciates volume of a solid body: intuitively and also by informal measurement.<br>• Uses addition and subtraction in finding time intervals in simple cases. |

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| | | | days between two dates. | |
| **Data Handling (8 hrs.)**<br><br>Collects, represents and interprets simple data. | **Data Handling (8 hrs.)**<br><br>• Collects data through measurement.<br>• Represents the data followed by discussion sorting by colour and size.<br>• Draws inferences from the data at the appropriate level. | **Data Handling (8 hrs.)**<br><br>• Records data using tally marks.<br>• Collects data and represents in terms of pictogram choosing appropriate scale and unit for display through pictogram.<br>• Draws conclusions from the data through discussion. | **Data Handling (8hrs.)**<br><br>• Collects data and represents in the form of bar graphs;<br>• Draws Inferences through discussions. | **Data Handling (8hrs.)**<br><br>• Collects two dimensional quantitative data.<br>• Represents the data in the form of a table.<br>• Draws a bar graph or a pictograph to present a data.<br>• Draws inferences through discussions. |
| **Patterns (14 hrs.)**<br><br>• Aquainly with sequences of simple patterns found in shapes in the surroundings e.g. stamping activity using fingers and thumb, using familiar objects etc.<br>Completes a given sequence of simple patterns found in shapes in the surroundings. | **Patterns (13 hrs.)**<br><br>• Extends patterns in sequence of shapes and numbers.<br>• Searches for patterns in different ways of splitting a number.<br>• Creates block patterns by stamping thumbprints, leaf prints, vegetable prints, etc.<br>Creates patterns of regular 2D shapes by stamping. | **Patterns (8 hrs.)**<br><br>• Identifies simple symmetrical shapes and patterns.<br>• Makes patterns and designs from straight lines and other geometrical shapes.<br>• Identifies patterns in the numerals for odd and even numbers and in adding odd and even numbers.<br>• Partitions a number in different ways.<br>• Identifies patterns in his surroundings based on shape, colour and size.<br>Identifies patterns in multiplication tables. | **Patterns (10 hrs.)**<br><br>• Identifies patterns in multiplication and division<br>eg: multiples of 9,<br>• Casts out nines from a given number to check if it is a multiple of nine.<br>• Identifies patterns.<br>• Multiplies and divides by 10s, 100s.<br>Identifies geometrical patterns based on symmetry. | **Patterns (10 hrs.)**<br><br>• Familarises square and triangular numbers through patterns.<br>• Relates sequences of odd numbers between consecutive square numbers.<br>Makes border strip and tiling patterns. |

# MATHEMATICS IN UPPER PRIMARY CLASSES

The development of the upper primary syllabus has attempted to emphasise the development of mathematical understanding and thinking in the child. It emphasises the need to look at the upper primary stage as the stage of transition towards greater abstraction, where the child will move from using concrete materials and experiences to deal with abstract notions. It has been recognised as the stage wherein the child will learn to use and understand mathematical language including symbols. The syllabus aims to help the learner realise that mathematics as a discipline relates to our experiences and is used in daily life, and also has an abstract basis. All concrete devices that are used in the classroom are scaffolds and props which are an intermediate stage of learning. There is an emphasis in taking the child through the process of learning to generalize, and also checking the generalization. Helping the child to develop a better understanding of logic and appreciating the notion of proof is also stressed.

The syllabus emphasises the need to go from concrete to abstract, consolidating and expanding the experiences of the child, helping her generalise and learn to identify patterns. It would also make an effort to give the child many problems to solve, puzzles and small challenges that would help her engage with underlying concepts and ideas. The emphasis in the syllabus is not on teaching how to use known appropriate algorithms, but on helping the child develop an understanding of mathematics and appreciate the need for and develop different strategies for solving and posing problems. This is in addition to giving the child ample exposure to the standard procedures which are efficient. Children would also be expected to formulate problems and solve them with their own group and would try to make an effort to make mathematics a part of the outside classroom activity of the children. The effort is to take mathematics home as a hobby as well.

The syllabus believes that language is a very important part of developing mathematical understanding. It is expected that there would be an opportunity for the child to understand the language of mathematics and the structure of logic underlying a problem or a description. It is not sufficient for the ideas to be explained to the child, but the effort should be to help her evolve her own understanding through engagement with the concepts. Children are expected to evolve their own definitions and measure them against newer data and information. This does not mean that no definitions or clear ideas will be presented to them, but it is to suggest that sufficient scope for their own thinking would be provided.

Thus, the course would de-emphasise algorithms and remembering of facts, and would emphasise the ability to follow logical steps, develop and understand arguments as well. Also, an overload of concepts and ideas is being avoided. We want to emphasise at this stage fractions, negative numbers, spatial understanding, data handling and variables as important corner stones that would formulate

the ability of the child to understand abstract mathematics. There is also an emphasis on developing an understanding of spatial concepts. This portion would include symmetry as well as representations of 3D in 2D. The syllabus brings in data handling also, as an important component of mathematical learning. It also includes representations of data and its simple analysis along with the idea of chance and probability.

The underlying philosophy of the course is to develop the child as being confident and competent in doing mathematics, having the foundations to learn more and developing an interest in doing mathematics. The focus is not on giving complicated arithmetic and numerical calculations, but to develop a sense of estimation and an understanding of mathematical ideas.

## GENERAL POINTS IN DESIGNING TEXT BOOK FOR UPPER PRIMARY STAGE MATHEMATICS

1. The emphasis in the designing of the material should be on using a language that the child can and would be expected to understand herself and would be required to work upon in a group. The teacher to only provides support and facilitation.
2. The entire material would have to be immersed in and emerge from contexts of children. There would be expectation that the children would verbalize their understanding, their generalizations, and their formulations of concepts and propose and improve their definitions.
3. There needs to be space for children to reason and provide logical arguments for different ideas. They are also to be expected to follow logical arguments and identify incorrect and unacceptable generalizations and logical formulations.
4. Children would be expected to observe patterns and make generalizations. Identify exceptions to generalizations and extend the patterns to new situations and check their validity.
5. Need to be aware of the fact that there are not only many ways to solve a problem and there may be many alternative algorithms but there may be many alternative strategies that maybe used. Some problems need to be included that have the scope for many different correct solutions.
6. There should be a consciousness about the difference between verification and proof. Should be exposed to some simple proofs so that they can become aware of what proof means.
7. The book should not appear to be dry and should in various ways be attractive to children. The points that may influence this include; the language, the nature of descriptions and examples, inclusion or lack of illustrations, inclusion of comic strips or cartoons to illustrate a point, inclusion of stories and other interesting texts for children.
8. Mathematics should emerge as a subject of exploration and creation rather than finding known old answers to old, complicated and often convoluted problems requiring blind application of un-understood algorithms.

9. The purpose is not that the children would learn known definitions and therefore never should we begin by definitions and explanations.
   Concepts and ideas generally should be arrived at from observing patterns, exploring them and then trying to define them in their own words.
   Definitions should evolve at the end of the discussion, as students develop the clear understanding of the concept.
10. Children should be expected to formulate and create problems for their friends and colleagues as well as for themselves.
11. The textbook also must expect that the teachers would formulate many contextual and contextually needed problems matching the experience and needs of the children of her class.
12. There should be continuity of the presentation with in a chapter and across the chapters. Opportunities should be taken to give students the feel for need of a topic, which may follow later.

# Class wise Course Structure in Mathematics at Upper Primary Stage

| Class VI | Class VII | Class VIII |
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| **Number System (60)**<br><br>**(i) Knowing our Numbers:**<br>Consolidating the *sense* of numberness up to 5 digits, Size, estimation of numbers, identifying smaller, larger, etc. Place value (recapitulation and extension), connectives: use of symbols =, <, > and use of brackets, word problems on number operations involving large numbers up to a maximum of 5 digits in the answer after all operations. This would include conversions of units of length & mass (from the larger to the smaller units), estimation of outcome of number operations. Introduction to a sense of the largeness of, and initial familiarity with, large numbers up to 10 digits and approximation of large numbers) Indian & International System of Numeration.<br><br>**(ii) Playing with Numbers:**<br>Simplification of brackets, Multiples and factors, divisibility rule of 2, 3, 4, 5, 6, 8, 9, 10, 11. (All these through observing patterns. Children would be helped in deducing some and then asked to derive some that are a combination of the basic patterns of divisibility.) Even/odd and prime/composite numbers, Co-prime numbers, prime factorization, every number can be written as products of prime factors. HCF and LCM, | **Number System (50)**<br><br>**(i) Knowing our Numbers:**<br>**Integers**<br>▪ Multiplication and division of integers (through patterns). Division by zero is meaningless<br>▪ Properties of integers (including identities for addition & multiplication, *commutative, associative, distributive*) through patterns). These would include examples from whole numbers as well. Involve expressing commutative and associative properties in a general *form*. Construction of counter-examples, including some by children. Counter examples like subtraction is not commutative.<br>▪ Word problems including integers (all operations)<br><br>**(ii) Fractions and rational numbers:**<br>▪ Multiplication of fractions<br>▪ Fraction as an operator<br>▪ Reciprocal of a fraction<br>▪ Division of fractions<br>▪ Word problems involving mixed fractions<br>▪ Introduction to rational numbers (with representation on number line)<br>▪ Operations on rational numbers (all operations) | **Number System (50)**<br><br>**(i) Rational Numbers:**<br>▪ Meaning of rational numbers, Properties of rational numbers – addition and multiplication – using general form of expression to describe the properties – closure, commutative, associative, distributive, existence of identity element and inverse element – consolidation of operations on rational numbers;<br>▪ Representation of rational numbers on the number line – to reinforce the above properties with simple problems;<br>▪ Between any two rational numbers there lies another rational number unlike for whole numbers (Making children see that if we take two rational numbers then we can keep finding more and more rational numbers that lie between them, unlike for two consecutive whole numbers);<br>▪ Verbal problems (higher logic, any two operations, including ideas like area …..) |

prime factorization and division method for HCF and LCM, the property LCM x HCF = product of two numbers. All this is to be embedded in contexts that bring out the significance and provide motivation to the child for learning these ideas.

### (iii) Whole numbers

Natural numbers, whole numbers, properties of numbers (commutative, associative, distributive, additive identity, multiplicative identity), number line. Seeing patterns, identifying and formulating rules to be done by children. *(As familiarity with algebra grows, the child can express the generic pattern.)*

### (iv) Integers

How negative numbers arise, models of negative numbers, connection to daily life, ordering of negative numbers, representation of negative numbers on number line. *Children to s*ee patterns, identify and formulate rules. What are integers, identification of integers on the number line, operation of addition and subtraction of integers, showing the operations on the number line (addition of negative integer reduces the value of the number) comparison of integers, ordering of integers,

### (v) Fractions:

Revision of what a fraction *is*, Fraction as a part of

- Representation of rational number as a decimal.
- Word problems on rational numbers (all operations)
- Multiplication and division of decimal fractions
- Conversion of units (lengths & mass)
- Word problems (including all operations)

### (iii) Powers:

- Exponents only natural numbers.
- Laws of exponents (through observing patterns to arrive at generalization.)

## Algebra (20)

## Algebraic Expressions

- Review of elementary concepts in Algebra.
- Identifying constants, coefficient, powers
- Like and unlike terms, degree of expressions e.g. $x\,y^2$ etc. (exponent ≤ 3 number of variables ≤ 2)
- Addition, subtraction of algebraic expressions (coefficients should be integers).
- Simple linear equations in one variable (in contextual problems) with two operations (avoid complicated coefficients)
- Multiplication of algebraic exp.(co-efficient should be integers)

## Ratio and Proportion (20)

- Ratio and proportion (revision)

### (ii) Squares, Square roots, Cubes, Cube roots.

- Meaning of square and square roots;

Finding square roots using factor method;

- Meaning of Cube and Cube root;

Finding Cube root by factor method (limiting to 6 digit, whole number);

- Estimating square roots and cube roots, learning the process of moving nearer to the required number.

### iii) Playing with numbers

- Writing and understanding a 2, 3 and 4 digit number in generalized form (e.g. 100a + 10b + c, where a, b and c can be digit 0 – 9) and engaging with various puzzles concerning this, (Like finding the missing numerals represented by alphabet in sums involving any of the four operations);
- Children to create and solve problems and puzzles;
- Number puzzles, games, magic squares (3x3 and 5x5 only);
- Deducing the divisibility test rules of 2, 3, 5, 9, 10 and 11 for a 2, 3 or 4 digit number expressed in the general form.

### iv) Commercial arithmetic

- Slightly advanced problems involving applications on percentages, profit and loss, discount, commission and simple

whole, Representation of fractions (pictorially and on number line), fraction as a division, proper, improper & mixed fractions, equivalent fractions, comparison of fractions, addition and subtraction of fractions (Avoid large and complicated unnecessary tasks). (Moving towards abstraction in fractions)

Review of the idea of a decimal *fraction*, place value in the context of decimal *fraction*, inter conversion of fractions and decimal fractions (no recurring decimals at this stage), comparison of two decimal fractions, addition and subtraction of decimal fractions upto 100th place.

Word problems involving addition and subtraction of decimals (two operations together on money,mass, length, temperature and time)

# Algebra (15)

## Introduction to Algebra

- Introduction to variable through patterns and through appropriate word problems and generalizations (example 5x1=5 etc.)
- Generate such patterns with more examples.
- Introduction to unknowns through examples with simple contexts (single operations)

# Ratio and Proportion (15)

- Concept of Ratio
- Proportion as equality of two ratios
- Unitary method (with only direct variation implied)
- Unitary method continued consolidation, general expression.

# Percentage-

- An introduction w.r.t life situation.
- Understanding percentage as a fraction with denominator 100
- Converting fractions and decimals into percentage and vice-versa.
- Application to profit & loss (single transaction only)
- Application to simple interest (time period in complete years)

# Geometry (60)

## (i) Understanding shapes:

- Pairs of angles (linear, supplementary, complementary, adjacent, vertically opposite) (verification and simple proof of vertically opposite angles)
- Properties of parallel lines with transversal (alternate, corresponding, interior, exterior angles)

## (ii) Properties of triangles:

- Angle sum property (with notions of proof & verification through paper folding, proofs using property of parallel lines, difference between proof and verification.)
- Exterior angle property
- Sum of two sides of a $\Delta$ > it's third side
- Pythagoras Theorem (Verification only)

problems on overhead expenses during commercial transactions and tax;

- Simple interest and advanced problems on simple interest using formula – completed years and fraction of years.

## v) Statistics

- Preparation of frequency distribution table;
- Representation of grouped data through bar graphs – construction and interpretation;
- Calculation of mean, median and mode for grouped data.

# Algebra (20)

## (i) Algebraic Expressions

- Meaning and types of polynomials;
- Revision of addition and subtraction of polynomials;
- Multiplication of Polynomials – monomials by monomials; binomial by monomial (a+b+c) x; Binomial by binomial (x+a) (x+b), $(a+b)^2$, $(a-b)^2$ and (a+b) (a-b) types (co-efficients should be integers);

## ii) <u>Factorisation</u>

- Revision of identities
  - (x+a) (x+b)= $x^2$+(a+b)x+ab;
  - $(a \pm b)^2 = a^2 \pm 2ab+b^2$ , a2-b2 =

- Word problems

# Geometry

## (i) Basic geometrical ideas (2 D): (65)

Introduction on to geometry. Its linkage with and reflection in everyday experience.

- Line, line segment, ray
- Open and closed figures.
- Interior and exterior of *closed* figures.
- Curvilinear and linear *boundaries*
- Angle - Vertex, arm, interior and exterior,
- Triangle- vertices, sides, angles, interior and exterior, altitude and median
- Quadrilateral- Sides, vertices, angles, diagonals, adjacent sides and opposite sides (only convex quadrilateral are to be discussed), interior and exterior of a quadrilateral.
- Circle- Centre, radius, diameter, arc, sector, chord, segment, semicircle, circumference, interior and exterior.

## (ii) Understanding Elementary Shapes (2 D and 3 D)

- Measure of Line segment
- Measure of angles
- Pair of lines
  - Intersecting and perpendicular lines
  - Parallel lines
- Types of angles- acute, obtuse, right, straight reflex, complete and zero angle
- *Classification* of triangles (*on the basis of* sides, and of angles)

## (iii) Symmetry

- Recalling symmetry
- Idea of rotational symmetry, observations of rotational symmetry of 2D objects. ($90^0$,$120^0$, $180^0$)
- Operation of rotation through $90^0$ &$180^0$ of simple figures.
- Examples of figures with both rotation and reflection symmetry (both operations)
- Examples of figures that have reflection and rotation symmetry and vice versa

## (iv) Representing 3D in 2D:

- Cuboids, cylinders, cones and tetrahedrons.
- Drawing 3D figures in 2D showing hidden faces.
- Identification & counting of vertices edges, faces, nets (for cubes cuboids, & cylinders, cones) using pictures.
- Matching pictures with objects (Identifying names)
- Representing the space around approximately through visual estimation.

## (v) Congruence

- Congruence through superposition (examples-coins, biscuits, bangles, , stamps, etc.)
- Extend congruence to simple geometrical shapes e.g. triangles, circles.

## (vi) Construction (Using scale, protractor, compass)

- Perpendicular bisector.
- Angle bisector- making angles of $30^0$ , $45^0$ , $90^0$ etc. (using compasses)

(a+b) (a-b);

- Factorisation of the type – $a(x+y)$, $(x \pm y)^2$, $(x+a)(x+b)$, $a^2 - b^2$

## iii) Linear equations

- Linear equation – meaning and general form, Solving linear equations in one variable in contextual problems involving multiplication and division – word problems (Avoid complicated co-efficients in the equations)

## iv) Exponents

- Integers as exponents;
- Laws of exponents with integral powers

## v) Introduction to graphs

- Preliminaries – Axes (same units), Cartesian plane, plotting points for different kinds of situations (perimeter vs length for square, plotting of multiples of different numbers, simple interest vs number of years, distance vs time etc);
- Reading off from the graphs – graphs obtained for the above situations;
- Plotting a linear graph; reading of linear graphs.

# Geometry (40)

## (i) Axioms, Postulates and

- Types of quadrilaterals – Trapezium, parallelogram, rectangle, square, rhombus
- Simple polygons *(introduction)* (Upto octagons regulars as well as non regular).
- *Identification of* 3-D shapes: Cubes, Cuboids, cylinder, sphere, cone, prism (triangular), pyramid (triangular & square) Identification and locating in the surroundings
- Elements of 3-D figures. (Faces, Edges and vertices)

## (iii) Symmetry: (reflection)

- Observation and identification of 2D symmetrical objects for reflection symmetry
- Operation of reflection (taking mirror images) of simple 2-d objects
- Recognising reflection symmetry (identifying axes)

## (iv) Constructions (using Straight edge Scale, protractor, compasses)

- Drawing of a line segment
- Construction of circle
- Perpendicular bisector
- Construction of angles (using protector)
- Angle $60^0$ , $120^0$ (Using Compasses)

## Mensuration (15)

## Concept of perimeter and introduction to area

- Angle equal to a given angle (using compass)
- Drawing a line perpendicular to a given line from a point **a)** on the line **b)** outside the line

- Construction of a line parallel to a given line from a point outside it.(Simple proof as remark with the reasoning of alternate angles)

## Mensuration (15)

- Revision of perimeter, Idea of $\pi$, Circumference of Circle

**Area**
Concept of measurement using a basic unit area of a square, rectangle, triangle, parallelogram and circle, area between two rectangles and two concentric circles.

## Data handling (15)

(i) Collection and organisation of data – choosing the data to collect for a hypothesis testing.
(ii) Mean, median and mode of ungrouped data understanding what they represent.
(iii) Constructing bar graphs
(iv) Feel of probability using data through experiments. Notion of chance in events like tossing coins, dice etc. Tabulating and counting occurrences of 1 through 6 in a number of throws. Preparing the bar graph.

## Theorems

- Meaning of axioms, postulates and enunciations, theorems and statements of these;
- Verification of the statements –
  - Wherever a ray meets a straight line at a point, the sum of the two adjacent angles formed is equal to two right angles;
  - If two lines intersect the vertically opposite angles are equal
  - Lines which are parallel to the same line are parallel to each other.
  - The angles opposite to equal sides of a triangle are equal – converse statement.
- Theorem 1 – If a transversal cuts two parallel lines then, a) alternate angles are equal b) the interior angles on the same side of the transversal are supplementary;
- Problems (numerical) and simple riders based on the theorem.

## ii) Theorem on triangles

- Theorem 2 – Sum of the three angles of a triangles is equal to two right angles; Exterior angles of a triangle – meaning;
- Theorem 3 – If one side of a triangle is produced, exterior angle so formed is equal to the sum of the interior opposite angles.

## iii) Congruency of triangles

- Meaning of congruency – congruency of

| | | |
|---|---|---|
| Introduction and general understanding *of perimeter* using many shapes. Shapes of different kinds with the same perimeter. Concept of area, Area of a rectangle and a square *Counter examples to different misconcepts related to perimeter and area.*<br>Perimeter of a rectangle – and its special case – a square. Deducing the formula of the perimeter for a rectangle and then a square through pattern and generalization.<br><br>**Data handling (10)**<br><br>(i) What is data - choosing data to examine a hypothesis?<br>(ii) Collection and organisation of data examples of organising it in tally bars and a table.<br>(iii) Pictograph- Need for scaling in pictographs interpretation & construction.<br><br>• Addition and subtraction of decimal fractions upto 100th place. | Comparing the observation with that for a coin. Observing strings of throws, notion of Randomness of ungrouped data. | plane figures, congruency of triangles;<br>▪ Postulates on congruency of triangles – SAS, SSS, ASA and RHS (Verification by practical method) – problems.<br><br>▪ Theorem 4: In an isosceles triangle, the angles opposite to equal sides are equal. (Logical proof based on the different postulates of congruency of triangles)<br>▪ Converse of the theorem, problems and riders based on the theorem.<br><br>▪ Theorem 5 -Two right angled triangles are congruent, if the hypotenuse and a side of one triangle is equal to the hypotenuse and a side of the other triangle, correspondingly.<br>▪ Simple riders based on the theorem.<br><br>**iv) Construction of triangles**<br>▪ Construction of all types of triangles based on angles and sides; -based on all criteria of data – SAS, SSS, ASA and RHS;<br>▪ Construction of a triangle given the base and sum/difference of the other two sides;<br>▪ Construction of a triangle given perimeter and base angles.<br><br>**v) Quadrilaterals**<br>▪ Definition of quadrilaterals – sides and angles (adjacent & opposite), diagonals;<br>▪ Property of quadrilaterals – sum of angles of a quadrilateral is equal to $360^{\circ}$ |

| | | |
|---|---|---|
| | | (by practical method);<br>▪ Types of quadrilaterals – Parallelogram-Rhombus, rectangle, square; Trapezium and isosceles trapezium;<br>▪ Properties of parallelogram (by practical method)<br>i) Opposite sides of a parallelogram are equal<br>ii) Opposite angles of a parallelogram are equal<br>iii) Diagonals of a parallelogram bisect each other<br>(Why iv, v, vi follow from the above)<br>iv) Diagonals of a rectangle are equal and bisect each other<br>v) Diagonals of a rhombus are equal and bisect each other at right angles<br>vi) Diagonals of a square are equal and bisect each other at right angles<br>▪ Problems and riders based on the above properties.<br>**Mensuration (15)**<br>▪ Surface area of a cube and cuboid; (both LSA and TSA)<br>▪ Volume and capacity – Measurement of capacity - basic unit of volume;<br>▪ Volume of a cube and cuboid. |

# Proposed Syllabus for Karnataka-Mathematics

## Standard IX

### I Arithmetic

**Unit 1.** Square-root

Finding the square-root of a perfect square number of at most 5 digits using division method; finding the square-root of a decimal number by division method; finding the square-root of a number which are not perfect squares like 2, 3, 5 up to 3 decimal places; learning the process of moving nearer to the square-root; verbal problems on square-roots.

**Unit 2.** Real Numbers

Basic properties of real numbers: closure, commutativity,associativity, distributivity, existence of additive identity, existence of additive inverse, existence of multiplicative identity, and existence of multiplicative inverse for non-zero real numbers; also order property(comparing one real number with another); non-negativity of the square of a real number; stress to be given for identifying rational numbers as those with recurring decimal expansion and irrationals as those with non-recurring decimal expansion.

**Unit 3.** Surds

Definition; order and radicund; index form; pure and mixed surds, and their mutual conversion; like and unlike surds; representing $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$ on the number line (assuming Pythagoras' theorem); knowing the position of $\sqrt{n-1}$ on the number line, to represent $\sqrt{n}$.

**Unit 4.** Sets

Set operations like union, intersection,; difference of sets; complement of a set; symmetric difference; representing all these using Venn diagram.

## Standard X

### I Arithmetic

**Unit 1.** Numbers

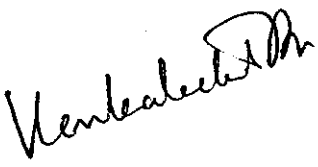
Euclid's lemma: given an integer $a$ and a positive integer $b$, there unique exist integers $k$ and $r$ such that $a = bk + r$, where $0 \leq r < b$; (This has been observed by the students, but formalised here.) Fundamental theorem of Arithmetic: any positive integer $n > 1$ can be expressed as a product of powers of prime numbers. (stress to be given to the fact that this factorisation is essentially unique in the sense that except for the order the prime powers are uniquely determined); the above properties without formal proof. As corollaries, the following to be proved: (i) if a prime divides the product of two integers, then it divides at least one of them, and (ii) if $a$ divides $bc$ and $\mathrm{HCF}(a, b) = 1$, then $a$ divides $c$. Proof of irrationality of $\sqrt{2}$, $\sqrt{3}$ and $\sqrt{5}$ using this.

**Unit 2.** Sets

Revision of set operations(union, intersection, set difference, complement, symmetric difference); properties of set operations: commutativity and associativity of union; commutativity and associativity of intersection; distributivity of union and intersection; DeMorgan's laws; relation between the number of elements in two sets to the number of elements in their union and intersection(principle of inclusion-exclusion): $n(A)+n(B) = n(A \cup B)+n(A \cap B)$.

**Unit 3.** Progressions

Concept of a sequence; Arithmetic progression: $n$-th term; sum of $n$ terms of an AP; problems based on this; Geometric progression: $n$-th term; sum to $n$ terms; sum of an infinite GP, when the common ratio $|r| < 1$; Harmonic progression: $n$-th term; arithmetic, geometric and harmonic mean of two positive real numbers; relation among them(AM $\geq$ GM $\geq$ HM); a simple proof based on $x^2 \geq 0$ for any real number $x$.



**Unit 5.** Statistics

Mean, median, mode of grouped and un-grouped data, a review; range; quartile deviation and mean deviation for a given grouped and un-grouped data; graphical representation; construction and interpretation of histograms of varying width, ogives and frequency polygons; review of random experiments leading to the concept of *chance* or *probability*.

## II Commercial Mathematics

**Unit 1.** Banking

Savings bank account; pass book and challan; cheques and drafts; calculation of interest on deposits in a savings bank account.

**Unit 2.** Compound interest

Definition of compound interest; difference between simple interest and compound interest; calculation of compound interest using ready recknors; derivation of compound interest formula; problems using formula.

**Unit 3.** Hire purchase and Installment

Meaning of hire purchase and installment buying; difference between them; calculation of interest in installment buying; some simple problems on how to calculate equated monthly installment (EMI).

**Unit 4.** Proportion

Meaning of proportion; general form; types-direct, inverse, compound proportions; Problems on time and work involving proportions.

**Unit 4.**

Permutation, Combination and Probability

Fundamental principle of counting; meaning of permutation; meaning of combination; notations for permutation and combination; difference between permutation and combination; problems based on these principles; random experiment; event; sample space; types of events(mutually exclusive, complementary, certain, impossible); definition of probability; problems on probability based on permutation and combination.

**Unit 4.** Statistics

Standard deviation of grouped and ungrouped data; calculation of standard deviation by direct method; coefficient of variation; construction and interpretation of pie-charts.

## III Algebra

**Unit 1.** Multiplication

Product of three binomials $(x+a)(x+b)(x+c)$ and related identity; identities for $(a+b)^3$, $(a-b)^3$; product of two trinomials $(a+b+c)^2$; conditional identities.

**Unit 2.** Factorisation

Standard identities: $a^2 - b^2 = (a-b)(a+b)$; $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$; $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$; factorisation using these identities; factorisation of a trinomial by splitting the middle term; involved problems on these identities.

**Unit 3.** HCF and LCM

Definition of HCF and LCM; finding HCF and LCM of binomials and trinomials using factorisation **Unit 4.** Division

Division of a monomial by a monomial; division of a polynomial by a binomial; division of a polynomial by a trinomial.

**Unit 5.** Simultaneous Linear Equations

Elimination method; word problems involving simultaneous equations; graph of the equation $ax + by = c$ (stress to be given to the fact that it represents a straight line in plane); solution of two simultaneous linear equations by drawing their graphs.

**Unit 6.** Variation

Definition; symbolic representation; constant of variation; types of variation - direct, inverse and compound; problems involving variation.

## II Algebra

**Unit 1.** Surds

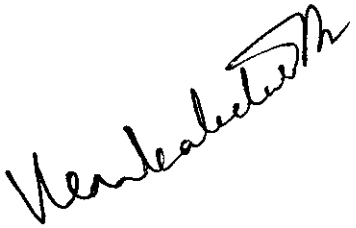
Like and unlike surds; addition, subtraction and multiplication rule(with simple problems); rationalisation of simple surds.

**Unit 2.** Polynomials

Division of one polynomial by another; concept of degree; synthetic division method; remainder theorem: $p(x) = (x-a)h(x) + p(a)$.

**Unit 3.** Quadratic equations

Meaning of a quadratic expression and a quadratic equation; simple problems on pure and adfected equations; solution by factorisation and its limitation; solution using formula (a formal derivation is needed); relation between roots and coefficients; discriminant and nature of roots; graphs of quadratic expressions(include some laws of Physics here to emphasise the importance of quadratic graphs); nature of quadratic expressions in terms of associated discriminant; factorising a quadratic expression using roots; forming quadratic equation, given its roots; graphical method of solving a quadratic equation; limitation of graphical method; word problems leading to quadratic equations.



**Appendix.** Proofs in Mathematics Concept of a proof; statement and its validity; axiom/postulates in Mathematics through familiar examples(drawing examples from geometry); the concept and nature of a proof(deductive nature based on the assumptions, the hypothesis and the logical structure); how to write a proof; stress on the fact that verification is not a proof; examples from various topics; ($n^2 + n + 41$ is a prime for $n = 1, 2, 3, \cdots, 40$, but not a prime for $n = 41$.) disproving a statement by a *counter example*; different types of proofs: deductive and proof by contradiction; converse of a statement; stress on that the validity of a statement does not imply the validity of its converse.

**Appendix.** Mathematical Modelling The concept of modelling; aims of modelling; real life situations leading to models; setting up hypothesis and looking for a model satisfying the hypothesis; solving the problem after setting up an appropriate model; reinterpretation of the problem in terms of the solution obtained by the model; examples from commercial mathematics leading to mathematical models.

**General Suggestions:**

1. Please include large number of multiple choice questions at the end of each chapter.
2. Give equal weightage to problems on a theorem, its converse and corollaries.
3. Include some harder problems at the end of each chapter to challenge students. These may starred and need not be worked out in a class room.

## IV Geometry

**Unit 1.** Polygons

Meaning of a polygon; interior and exterior angles; convex and concave polygons; regular and irregular polygons; the sum of interior angles of a polygon(both for convex and concave polygons); sum of the exterior angles; inscribing a regular polygon of $n$ sides in a circle, for $n = 3, 4, 5, 6, 8$.

**Unit 2.** Quadrilaterals

Revision of basics of quadrilaterals: Definition; sides, angles and diagonals. Properties of quadrilaterals; construction of quadrilaterals given any 5 elements; area of a quadrilateral; types of quadrilaterals: parallelogram, rhombus, trapezium; construction of a parallelogram (given adjacent sides and an angle; adjacent sides and a diagonal); construction of a rhombus (given two diagonals; one side and one diagonal); construction of a trapezium (given four sides; parallel sides and the altitude); area of a parallelogram; area of a rhombus; area of a trapezium.

**Unit 3.** Theorems and problems on parallelogram

**Theorem:** Each diagonal of a parallelogram divides the parallelogram in to two congruent triangles. The diagonals of a parallelogram bisect each other.

Corollaries this result.

**Theorem :** Two parallelograms standing on the same base and between the same parallels have same area.

**Theorem :** (Mid-point theorem) The line joining the mid-points of any two sides of a triangle is parallel to the third side and equal to half the third side. Conversely, if a line joining two points on two sides of a triangle is parallel to the third side and has length equal to half the third side, then it must be passing through the mid-points.

Some riders on each of these theorems.

**Unit 4.** Circles

Revision of basic notions (definition; radius; diameter; chord arc; angle at the centre subtended by an arc; angle at a point on the circle subtended by an arc; chord); a chord divides the circle in to two arcs, minor and major arc; properties of chords (observation that perpendicular from the centre bisects a chord, using practical work); equal chords are equidistant from the centre and its converse(again by practical work).



## III Geometry

**Unit 1.** Triangles

Similarity of triangles; basic proportionality theorem(Thale's theorem); a formal proof using areas;

**Theorem:** If two triangles are equiangular, their corresponding sides are proportional.

**Theorem:** If two triangles are similar, then the ratio of their areas is equal to the square of the ratio of any two corresponding sides.

Revision of right-angled triangles leading to Pythagoras' theorem.

**Theorem:** (Pythagoras) In a right-angled triangle, the square on the hypotenuse is the sum of the squares on the other two sides.

Problems based on Pythagoras theorem.

**Theorem:** (Converse of Pythagoras theorem) If in a triangle, the square on one side is equal to the sum of the squares on the remaining two sides, then the angle opposite to the larger side is a right-angle.

Problems based on this result.

**Unit 2.** Circles

Meaning of tangent; point of contact; properties of a tangent: radius drawn from the point of contact of a tangent to the circle is perpendicular to the tangent – converse of this statement(no proof, only verification). Meaning of touching circles – touching externally and touching internally; common tangents – direct and transverse.

**Theorem:** If two circles touch each other, then the centres and the point of contact are collinear.

**Theorem:** The tangents drawn from an external point to a circle are (i) equal, (ii) equally inclined to the line joining the point to the centre, and (iii) subtend equal angles at the centre.

**Unit 3.** Constructions

Construction of chord of given length; verification of the properties: (i) equal chords are equi-distant from the centre; (ii) angles in the same segment are equal; (iii)angles in the major-segment are acute angles; angles in the minor-segment are obtuse angles; and angles in the semi-circle are right-angles.